PROC. BIOL. SOC. WASH.
105(1), 1992, pp. 165–179

MORPHOLOGY AND TAXONOMY OF TWO NEW SPECIES OF MARINE CILIATES (CILIOPHORA: SPIROTRICHEA: STICHOTRICHIDA: AMPHISIELLIDAE)

Gregorio Fernandez-Leborans and Apolonia Novillo

Abstract.—The morphological characteristics of two ciliate marine protozoan species of subclass Stichotrichia (*Amphisiella ovalis* and *A. arenicola*) are described, with special emphasis on the infraciliature of these organisms. A statistical study has been made of the most important morphological features. The organisms were classified through a comparative analysis with the most similar species.

The "hypotrichs" constitute one of the groups of ciliate protozoa most studied (Corliss 1979). The traditionally well known "hypotrichs" had formed a unique taxonomic group until several years ago: the order Hypotrichida Stein, 1859 (Honigberg et al. 1964, Levine et al. 1980). However, recently, the species of these ciliates have been included in two major groups: subclass Stichotrichia Small & Lynn, 1985 and subclass Hypotrichia Small & Lynn, 1985, that differ mainly regarding to the kinetosomic derivatives of the somatic and oral infraciliature (Lee et al. 1985).

Most ciliate species described, including the "hypotrichs," come from freshwater environments (Kahl 1935; Song & Wilbert 1989; Dragesco & Dragesco-Kérneis 1986; Foissner 1979, 1982, 1988; Blatterer & Foissner 1988). The marine forms are least well known (Dragesco 1960; Agamaliev 1983; Borror 1963, 1965), due on the one hand to fixation and impregnation problems that involve the salt water, and on the other hand to the fact that an important fraction of species pertain to interstitial (psammophilic) fauna and wherein there are difficulties in separating the organisms from the sediment. We have described some marine ciliate species (Fernandez-Leborans 1984a; Fernandez-Leborans & Castro de Zaldumbide 1984, 1985, 1986a, 1986b). Taking into account the modifications of some removal and staining techniques (Fernandez-Leborans & Castro de Zaldumbide 1986a, Fernandez-Leborans 1990), we have studied the morphology of two marine "hypotrichs." The results are shown below.

Methods

The samples were collected in a littoral area of: a) the Mediterranean Sea (Gandía, Spain) (Species I) from a beach zone situated at 38°01′42″N and 0°10′28″E; b) the Cantabric Sea (Castrourdiales, Spain), beside the Atlantic Ocean, a beach zone facing north towards the open sea, at 43°22′N and 0°28′W. The method described by Fernandez-Leborans (1990) was used for ciliates removal, utilizing an initial fixation of 0.3% formaldehyde in sea water. The specimens were treated with the silver carbonate technique (Fernandez-Leborans & Castro de Zaldumbide 1986a) for the observation of infraciliature components and other morphological structures. Photomicrographs and drawings with a camera lucida were obtained from microscopical observation of permanent preparations. The measures were made with an ocular micrometer.

Results

Species I

General morphology.—Organisms elongated ovals, with dorsal and ventral sides flattened. Length of the body varies between

132 μm and 162 μm; width, 37.5 to 67.5 μm. Two oval macronuclei located in middle region of ciliate, each measuring 19.5–31.5 μm long and 9–13.2 μm wide. Beside each macronucleus is an oval micronucleus measuring 6.75–7.5 μm long and 3.15–4.5 μm wide (in some specimens a total of three micronuclei were observed). Ciliature developed most profusely on ventral surface of ciliate, while on dorsal surface there are only 5–6 kineties. Ventral ciliature forms two groups of structures: the oral ciliature and the cirri.

The oral ciliature.—Located on left side of ventral surface. Oral area has a length of 55.5–64.8 μm and a width of 9–21 μm. Its posterior end is 81–99 μm the posterior pole of ciliate, consisting of two structures: the 'adoral organelles zone' (AO) and the 'paroral formation' (PF).

Adoral zone of organelles (AO) is 72–88.5 μm long and situated near left side of ciliate and following the edge of anterior pole of the organism and a part of anterior right side. It comprises 36–42 organelles (polykineties), which are disposed in three zones: a) an 'anterior part' with 15–17 organelles is located on area situated in the anterior left part, the anterior end and a small segment of anterior right edge of ventral surface; organelles of this zone are a length of 2.1–3.15 μm. These structures have three parallel kineties, with 2, 6 and 6 kinetosomes each; b) an 'intermediate part' of 16–19 organelles located on left side of ciliate. Each organelle has a length of 4.5–6.22 μm and is composed of three rows (with 2, 10–14 and 10–14 kinetosomes each); c) a 'posterior part' which is the region nearest to equator of organism. It consists of 5–6 organelles; each organelle 1.2–2.4 μm long and having 2 rows of 6–8 kinetosomes each. On the most posterior segment of this part, the next to last organelle has 2 rows of 4 kinetosomes each, and the last organelle is composed of 2 rows of 2 kinetosomes each.

The 'paroral formation' (PF) delimits the right side of oral area and is formed of two components: 1) 'paroral formation 1' (PF1) nearest to adoral zone of organelles, and 2) 'paroral formation 2' (PF2) located beside the frontal cirri of ciliate. Paroral formation 1 is 25.5–28.8 μm long and has a single row of 60–68 kinetosomes (stichomonad). Paroral formation 2 is 30–35 μm and is formed of 50–52 pairs of kinetosomes (diplostichomonad or diplokinety). In some specimens this structure (PF2) appears divided in two segments: PF2a, anterior, smaller (12–13.8 μm long), and PF2b, posterior (18–21 μm long).

The cirri.—Located on ventral surface of ciliate. There are five groups of cirri: frontal cirri (FC), right marginal cirri (RMC), left marginal cirri (LMC), ventral cirri (VC) and transverse cirri (TC). No caudal cirri are present.

Frontal cirri (FC).—Situated in anterior region of ciliate, between right side and paroral formation. There are four anterior cirri of similar size and three posterior cirri or frontoterminal cirri of lesser size. These last cirri are located near the anterior end of right marginal cirri. Each anterior frontal cirrus is 1.68–2.34 μm and has four rows of 4–6 kinetosomes each. Each frontoterminal cirri is 1.28–1.75 μm long and consists of three rows of 3–4 kinetosomes each.

Right marginal cirri (RMC).—Occupy a zone of 82.5–93 μm long on right side of ventral surface, between anterior region near frontoterminal cirri and posterior part close to transverse cirri of organism. There are 50–54 right marginal cirri, each of them with a length of 2.4–3.2 μm and two rows of 6–8 kinetosomes each. From each cirrus there is a thick derivative running from cirrus to anterior right side of ciliate. This derivative (d1) has a length of 1.6–2.1 μm.

Left marginal cirri (LMC).—Are included in an area 102–118.5 μm long located on left side of ventral surface between anterior zone near adoral organelles and posterior end of ciliate. There are 48–50 cirri of this type, each of them is 2.34–2.64 μm long and one has two rows of 4–6 kinetosomes each.

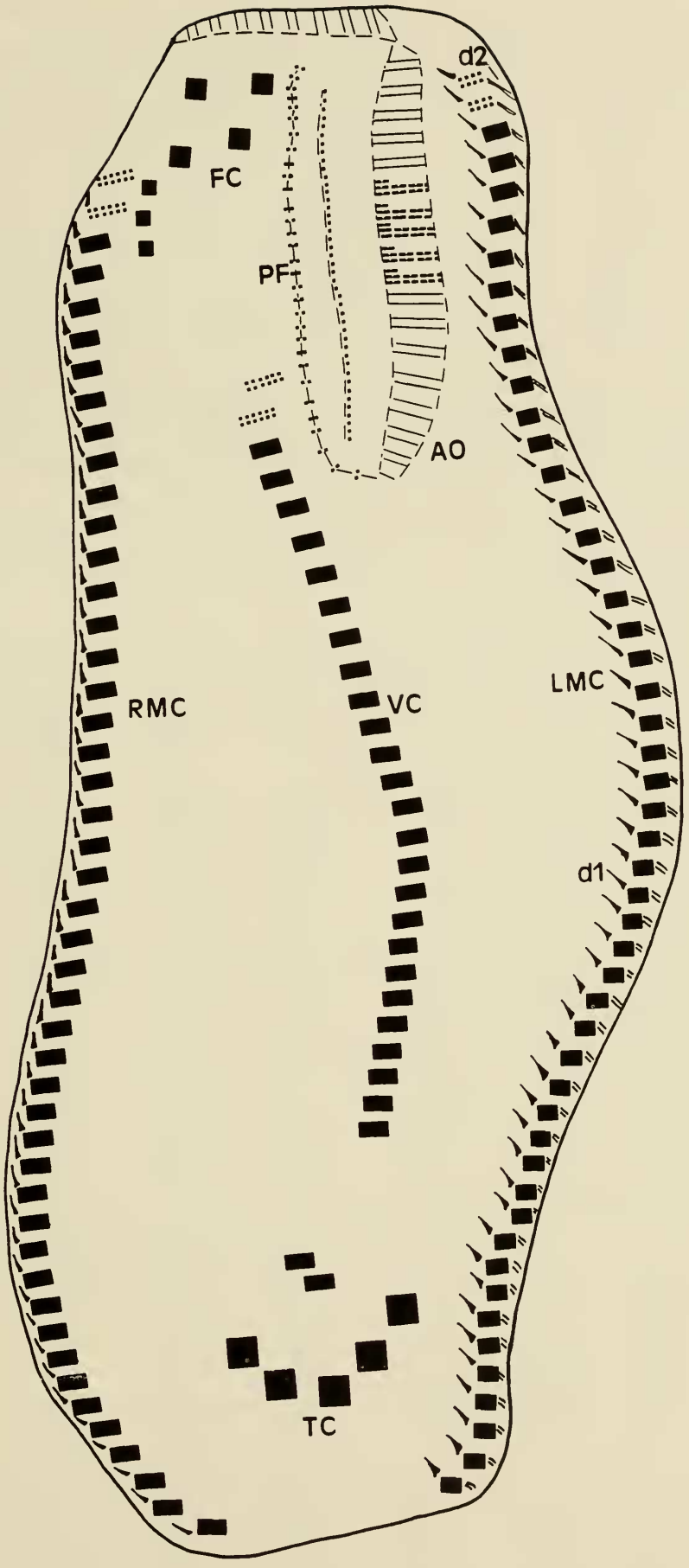

Fig. 1. Infraciliature of *Amphisiella arenicola*. FC, frontal cirri. AO, adoral zone of organelles. RMC, right marginal cirri. LMC, left marginal cirri. VC, ventral cirri. PF, paroral formation. TC, transverse cirri. d1 and d2, kinetosomal derivatives.

Table 1.—Morphometric data on *Amphisiella arenicola*. A, arithmetic mean. B, standard deviation. C, standard error. D, Pearson coefficient. E, coefficient of variation. F, minimum. G, maximum. 1, length of body. 2, width of body. 3, length of each macronucleus. 4, width of each macronucleus. 5, length of the micronucleus. 6, width of the micronucleus. 7, length of the oral area. 8, width of the oral area. 9, length of the right marginal cirri zone. 10, length of the ventral cirri zone. 11, length of the left marginal cirri zone. 12, length of each ventral cirrus. 13, length of each right marginal cirrus. 14, length of each left marginal cirrus. 15, length of each cirrus located directly above the transverse cirri. 16, length of each transverse cirrus. 17, width of each transverse cirrus. 18, length of derivative *1* of the right marginal cirri. 19, length of the derivative *1* of the left marginal cirri. 20, length of derivative *2* of the left marginal cirri. 21, length of the segment *a* of the paroral formation 2 (PF2). 22, length of the segment *b* of the paroral formation 2. 23, length of the paroral formation 1 (PF1). 24, distance between anterior pole and the anterior end of the ventral cirri zone. 25, distance between the anterior pole and the posterior end of the ventral cirri zone. 26, distance between the anterior pole and the anterior end of the transverse cirri zone. 27, distance between the posterior end of the oral area and the posterior pole. 28, length of the adoral zone of organelles (AO). 29, length of each organelle on the anterior part of AO. 30, length of each organelle on intermediate part of AO. 31, length of each organelle on the posterior part of AO. 32, length of each anterior frontal cirrus. 33, width of each anterior frontal cirrus. 34, length of each frontoterminal cirrus. 35, width of each frontoterminal cirrus. 36, distance between the cirri located directly above the transverse cirri and the transverse cirri. 37, distance between the cirri located directly above the transverse cirri and the posterior end of the ventral cirri zone. 38, number of ventral cirri. 39, number of right marginal cirri. 40, number of left marginal cirri. 41, number of transverse cirri. 42, number of adoral organelles. 43, number of kinetosomes of the paroral formation 2 (PF2). 44, number of kinetosomes of the paroral formation 1 (PF1). 45, number of dorsal kineties. (Number of observations: 80.)

	1	2	3	4	5	6	7	8	9
A	144.15	43.53	24.12	11.60	7.06	3.47	60.26	13.64	85.98
B	6.63	7.71	3.11	1.07	0.23	0.38	2.26	2.88	2.67
C	0.74	0.86	0.34	0.12	0.02	0.04	0.25	0.32	0.29
D	0.24	0.13	0.68	0.37	−0.13	−0.33	0.55	0.56	−0.11
E	4.60	17.73	12.90	9.22	3.25	10.95	3.76	21.12	3.10
F	132.00	37.50	19.50	9.00	6.75	3.15	55.50	9.00	82.50
G	162.00	67.50	31.50	13.20	7.50	4.50	64.80	21.00	93.00
	10	11	12	13	14	15	16	17	18
A	81.40	112.78	2.42	2.88	2.45	2.27	2.11	1.44	1.82
B	2.70	3.83	0.44	0.23	0.08	0.08	0.25	0.08	0.11
C	0.30	0.42	0.04	0.02	0.009	0.009	0.02	0.08	0.01
D	0.44	0.07	0.51	0.37	0.44	−0.25	0.07	0.59	0.21
E	3.31	3.40	18.16	7.98	3.27	3.59	11.84	5.55	6.09
F	78.00	102.00	1.80	2.40	2.34	2.10	1.50	1.35	1.62
G	89.00	118.50	3.60	3.25	2.64	2.40	2.45	1.65	2.10
	19	20	21	22	23	24	25	26	27
A	3.92	7.75	13.10	19.33	26.94	29.98	108.81	120.83	85.85
B	0.51	0.69	0.48	0.76	0.81	1.34	3.62	1.23	5.49
C	0.05	0.07	0.05	0.08	0.09	0.15	0.40	0.13	0.61
D	0.23	0.21	0.42	0.43	−0.19	0.73	0.22	0.51	0.33
E	13.01	8.95	3.66	3.97	3.00	4.48	3.32	1.01	6.39
F	2.92	6.60	12.00	18.00	25.50	28.50	100.50	118.00	81.00
G	5.25	9.60	13.80	21.00	28.80	33.00	117.00	123.00	99.00
	28	29	30	31	32	33	34	35	36
A	80.33	2.79	5.64	1.87	1.76	1.47	1.46	1.50	8.47
B	3.77	0.32	0.40	0.39	0.18	0.11	0.16	0.09	0.75
C	0.42	0.03	0.04	0.04	0.02	0.01	0.01	0.01	0.08
D	0.24	−0.62	0.11	−0.36	0.34	0.36	0.74	−0.11	0.09

Table 1.—Continued.

	28	29	30	31	32	33	34	35	36
E	4.69	11.46	7.09	20.85	10.22	7.48	10.95	6.06	8.85
F	72.00	2.10	4.50	1.20	1.68	1.38	1.28	1.31	7.50
G	88.50	3.15	6.22	2.40	2.34	1.80	1.75	1.70	10.50
	37	38	39	40	41	42	43	44	45
A	13.02	53.66	52.16	49.00	5.16	38.33	50.58	63.91	5.66
B	0.57	1.15	1.02	0.73	0.38	1.55	0.79	1.88	0.49
C	0.06	0.12	0.11	0.08	0.04	0.17	0.08	0.21	0.05
D	0.22	−0.28	0.16	0.00	0.42	0.21	0.73	−0.04	−0.67
E	4.42	2.14	1.95	1.48	7.35	4.06	1.56	2.94	8.68
F	12.00	52.00	50.00	48.00	5.00	36.00	50.00	60.00	5.00
G	14.25	56.00	54.00	50.00	6.00	42.00	52.00	68.00	6.00

There is a kinetosomic derivative with an arrangement similar to derivative 'd1' of right marginal cirri, although it is larger (2.92–5.25 μm). Also, each of these cirri has another derivative, like a bundle situated from cirrus to left posterior region of ventral surface. It is 6.6–9.6 μm long.

Ventral cirri (VC).—This group is arranged anteroposteriorly in middle zone of ventral surface, from region close to half of paroral formation 2 (PF2) to posterior region of body. The ventral cirri zone is 78–89 μm long and its anterior end is located 100.5–117 μm from anterior end of ciliate. There are 52–56 ventral cirri, each one with a length of 1.8–3.6 μm and composed of two rows of 6–8 kinetosomes each. Slightly separated from ventral cirri zone there are 2 cirri located directly above the transverse cirri. These cirri are 12–14.2 μm from posterior end of ventral cirri zone and they are 7.5–10.5 μm from the transverse cirri. Each of these cirri has a length of 2.1–2.4 μm and comprises two rows of 5–6 kinetosomes each.

Transverse cirri (TC).—There are 5–6 transverse cirri located near posterior pole of ciliate. These cirri are 118–123 μm from anterior pole of organism. Each cirrus has a length of 1.5–2.4 μm and a width of 1.35–1.65 μm, and consists of four rows of 3–4 kinetosomes each (Fig. 1, Table 1).

Species II

General morphology.—Oval in shape, with posterior end rounded and anterior end slightly pointed. Ciliates 49.5–63 μm long and 27–46.5 μm wide. Oral area occupies a region on left anterior part of ventral surface and has a length of 18–26.2 μm and a width of 10.5–12.7 μm. Scattered in the ciliate are 32–45 macronuclear nodes, each of them 4.2–9 μm long and 2.1–4.4 μm wide. There are 2–4 micronuclei that have a length of 1.56–2.04 μm each.

Most of the ciliature is located on ventral surface. On the dorsal side there are only four kineties. Ventral ciliature arranged in two structures: oral ciliature and cirri (Fig. 2, Table 2).

Oral ciliature.—Is composed of the adoral zone of organelles (AO) and the paroral formation (PF).

The 'adoral zone of organelles' (AO) is located around left anterior edge of ciliate, and surrounding anterior pole of organism. It has a length of 24–31.2 μm and is formed of 16–19 organelles. On middle region of this zone each organelle has four rows of kinetosomes: a short row of 3–4 kinetosomes, an intermediate row of 9–10 kinetosomes and two parallel rows of 15–16 kinetosomes each. The length of these organelles is 7.8–9 μm. In the posterior end

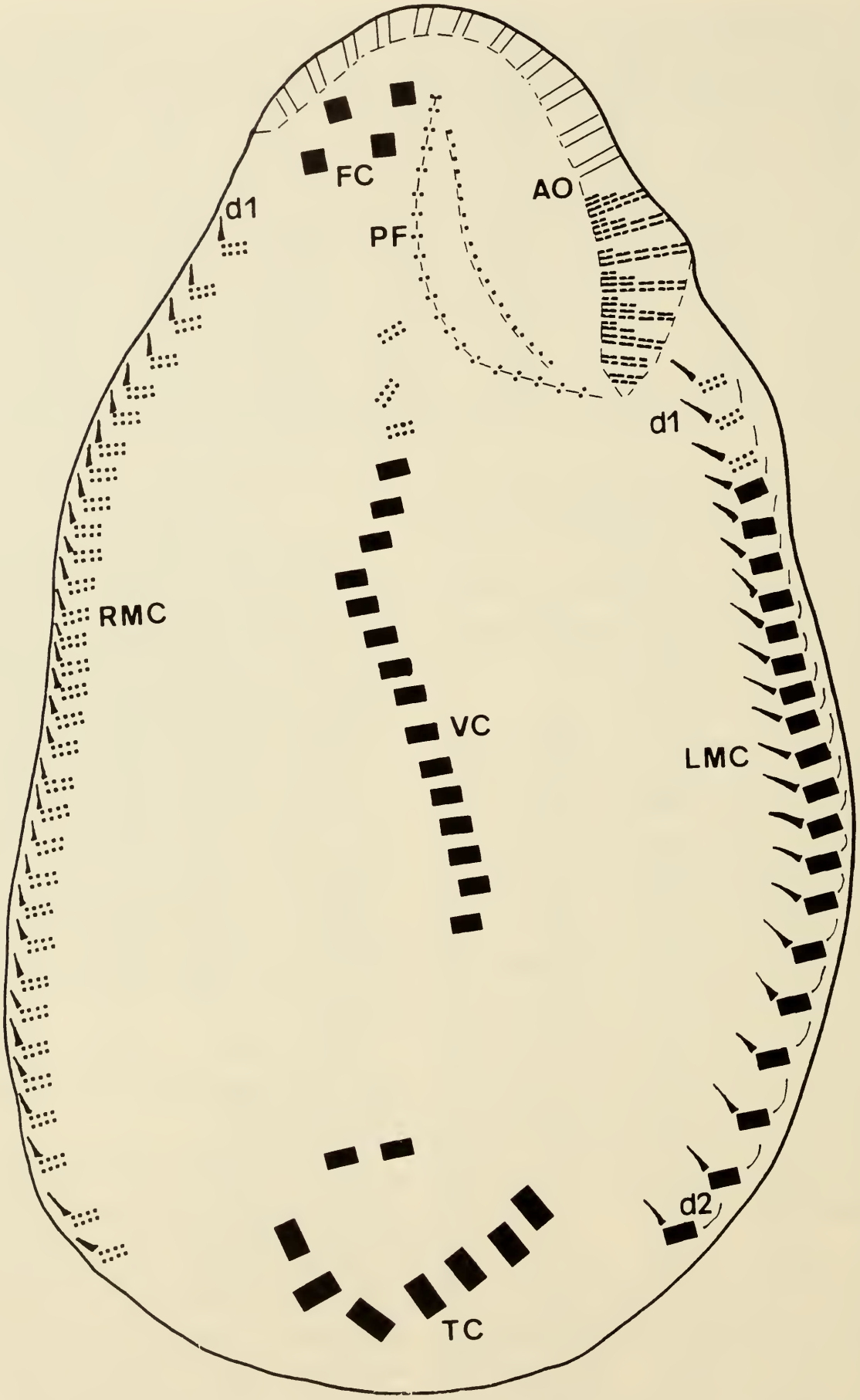

Fig. 2. Infraciliature of *Amphisiella ovalis*. FC, frontal cirri. AO, adoral zone of organelles. PF, paroral formation. RMC, right marginal cirri. LMC, left marginal cirri. VC, ventral cirri. TC, transverse cirri. d1 and d2, kinetosomal derivatives.

Table 2.—Morphometric data on *Amphisiella ovalis*. A, arithmetic mean. B, standard deviation. C, standard error. D, Pearson coefficient. E, coefficient of variation. F, minimum. G, maximum. 1, length of the body. 2, width of the body. 3, length of the oral area. 4, width of the oral area. 5, length of each macronuclear node. 6, width of each macronuclear node. 7, length of each micronucleus. 8, length of the adoral zone of organelles (AO). 9, length of the paroral formation 1 (PF1). 10, length of the paroral formation 2 (PF2). 11, length of each organelle of AO (middle region). 12, length of the left marginal cirri zone. 13, length of the right marginal cirri zone. 14, length of the ventral cirri zone. 15, length of derivative *d1* of the left marginal cirri. 16, length of derivative *d2* of the left marginal cirri. 17, length of derivative *d1* of the right marginal cirri zone. 18, distance between the posterior end of the transverse cirri zone and the anterior pole. 19, distance between the posterior end of the transverse cirri zone and the posterior pole. 20, distance between the posterior end of the ventral cirri zone and the anterior pole. 21, distance between the anterior end of the left marginal cirri zone and the anterior pole. 22, number of adoral organelles. 23, number of kinetosomes of the paroral formation 1 (PF1). 24, number of kinetosomic pairs of the paroral formation 2 (PF2). 25, number of right marginal cirri. 26, number of left marginal cirri. 27, number of ventral cirri. 28, number of macronuclear nodes. 29, number of transverse cirri. 30, number of micronuclei. 31, length of each frontal cirrus. 32, width of each frontal cirrus. 33, length of each right marginal cirrus. 34, length of each left marginal cirrus. 35, length of each ventral cirrus. 36, distance between the transverse cirri zone and the cirri located directly above the transverse cirri. 37, length of each transverse cirrus. 38, width of each transverse cirrus. 39, length of each cirrus located directly above the transverse cirri. (Number of observations: 80.)

	1	2	3	4	5	6	7	8	9	10
A	55.09	31.01	21.58	11.44	5.93	3.80	1.91	29.13	15.44	20.68
B	4.30	5.02	1.95	0.54	1.08	0.56	0.12	2.36	0.65	0.45
C	0.48	0.56	0.21	0.06	0.12	0.06	0.01	0.26	0.07	0.05
D	0.62	0.40	0.50	0.25	0.30	0.00	0.12	−0.45	0.66	0.18
E	7.80	16.18	9.03	4.72	18.21	14.73	6.28	8.10	4.20	2.17
F	49.50	27.00	18.00	10.50	4.20	2.10	1.56	24.00	14.40	19.80
G	63.00	46.50	26.20	12.70	9.00	4.40	2.04	31.20	16.80	21.60
	11	12	13	14	15	16	17	18	19	20
A	8.29	41.12	54.00	28.90	3.79	2.23	2.85	48.51	8.11	46.78
B	0.34	2.80	1.90	1.30	0.44	0.17	0.24	1.76	0.90	0.83
C	0.03	0.31	0.21	0.14	0.04	0.01	0.02	0.19	0.10	0.09
D	0.01	−0.34	0.31	0.23	−0.003	0.20	−0.59	0.29	1.01	0.45
E	4.10	6.80	3.51	4.49	11.60	7.62	8.42	3.62	11.09	1.77
F	7.80	36.30	50.10	26.50	2.46	1.86	2.40	45.00	6.60	45.00
G	9.00	45.00	58.50	31.60	4.20	2.52	3.18	52.50	9.60	48.20
	21	22	23	24	25	26	27	28	29	30
A	23.19	17.50	23.25	25.33	31.33	22.41	19.66	40.25	6.75	2.50
B	0.52	0.90	1.05	0.88	0.88	1.08	1.07	3.69	0.45	0.79
C	0.05	0.10	0.11	0.09	0.09	0.12	0.11	0.41	0.05	0.08
D	0.17	−0.55	0.23	−0.75	−0.75	0.38	−0.31	−0.47	−0.55	0.62
E	2.24	5.14	4.51	3.47	2.80	4.81	5.44	9.16	6.70	31.90
F	22.80	16.00	22.00	24.00	30.00	20.00	18.00	32.00	6.00	2.00
G	24.60	19.00	25.00	26.00	32.00	24.00	22.00	45.00	7.00	4.00
	31	32	33	34	35	36	37	38	39	
A	2.32	1.45	1.74	1.69	1.75	5.52	1.76	1.05	1.58	
B	0.08	0.08	0.07	0.04	0.06	0.29	0.06	0.07	0.06	
C	0.009	0.009	0.008	0.004	0.007	0.03	0.006	0.008	0.007	
D	0.24	0.61	0.45	0.41	0.48	0.40	0.48	−0.57	0.31	
E	3.81	6.10	4.47	2.50	3.69	5.42	3.42	7.44	4.32	
F	2.10	1.38	1.56	1.62	1.69	4.80	1.62	0.96	1.44	
G	2.46	1.68	1.86	1.80	1.92	6.00	1.86	1.20	1.74	

Table 3.—Comparison among the most similar species. a, *Amphisiella terricola* (Hemberger, 1982). b, *Holostichides terricola*. c, *Amphisiella australis* (Population I). d, *Amphisiella australis* (Population II). e, *Amphisiella magnigranulosa*. f, *Trachelochaeta gonostomoida*. g, *Uroleptoides atypica*. h, *Uroleptoides binucleata*. i, *Uroleptoides caudata*. j, *Amphisiella capitata*. k, *Amphisiella acuta*. l, *Perisincirra gellerti* (Population I). m, *Perisincirra gellerti* (Population II). n, *Amphisiella terricola*. o, *Amphisiella oscensis*. p, *Amphisiella milnei*. q, *Amphisiella arenicola* (Species I). r, *Amphisiella ovalis* (Species II). 1, length of the body. 2, width of the body. 3, length of the adoral zone of organelles. 4, length of each macronucleus. 5, width of each macronucleus. 6, length of the

	1	2	3	4	5	6	7	8
a	190–230	85–100	41 (d)	23.3–25 (d)	14–15 (d)	6.6 (d)	2	2
b	72–115	14–19	18–23	3–10	2–5	2–3	14–18	2–5
c	98–145	32–48	22–29	17–22	9–11	3–4	2	2–5
d	87–122	24–49	16–25	11–20	7–9	3–4	2	1–4
e	84–123	40–56	21–28	15–24	6–10	3–4	2	2–6
f	110–200	30–50	37 (d)	15–16 (d)	8–10 (d)	3.8 (d)	2	2
g	200	30–40	30 (d)	3.7–7.5 (d)	2.5–4 (d)	3–5 (d)	23	2
h	220–260	50	35 (d)	30 (d)	11–13 (d)	5.8 (d)	2	2
i	200	50	22 (d)	5–6.8 (d)	3–4.3 (d)	2.5 (d)	14	4–6
j	65 (d)	18 (d)	46 (d)	—	—	—	—	—
k	86–147	14–17	13–16	4–6.4	1.4–2.6	1.5 (d)	24–38	2
l	50–79	11–15	14–18	2.6–8	1.5–5.3	1.3 (d)	6–13	2
m	48–65	9–14	13–21	4–8	2–4	1.3 (d)	6–8	2
n	86–108	38–55	27–28	11–15	10–11	2.3 (d)	2	2
o	77–81	31–33	30.4	17	9.1	1.36	2	2
p	120	35	65 (d)	20–24 (d)	8–11 (d)	2 (d)	2	2–3
q	132–162	37.5–67.5	72–88	19.5–31.5	9–13.2	6.7–7.5	2	2–3
r	49–63	27–46	24–31.2	4.2–9	2.1–4.4	1.5–2.04	32–45	2–4

of the adoral zone the last organelle has two rows of 6–8 kinetosomes each.

The 'paroral formation' (PF) delimits the right side of the buccal cavity. It consists of two structures: a) an internal part (PF1), which is shorter, has a single row (stichomonad) of 22–25 kinetosomes, and is 14.4–16.8 μm long; b) an external part (PF2), which is longer than PF1 and reaches the posterior end of the adoral zone. It is 19.8–21.6 μm long and comprises 24–26 pairs of kinetosomes (diplostichomonad).

The cirri.—There are five types of cirri: frontal (FC), right marginal (RMC), left marginal (LMC), ventral (VC) and transverse (TC). No caudal cirri are present.

Frontal cirri (FC).—Located in anterior area of ventral surface, between paroral formation and right side. There are four frontal cirri, each of them having a length of 2.1–2.46 μm and a width of 1.38–1.68 μm. Each cirrus consists of four rows of kinetosomes of which number varies on different cirri. On frontal cirrus F1 (the most anterior and close to paroral formation) there is a row of 3–4 kinetosomes and three rows of 4 kinetosomes each. On F2 cirrus (anterior and close to right side of ventral surface) there is a row of 4–6 kinetosomes and three rows of 6 kinetosomes each. On F3 cirrus (posterior and near to paroral formation) there are four rows of 6 kinetosomes each. On F4 cirrus (posterior and close to right side of ventral surface) there are two rows of 6 kinetosomes each and two rows of 6–8 kinetosomes each.

Right marginal cirri (RMC).—They occupy a great part of right border on ventral surface of ciliate. The zone of these cirri has a length of 50.1–58.5 μm; its anterior end is located near anterior end of adoral zone of organelles that overhang in right side and its posterior end is situated near to posterior pole of ciliate. There are 30–32 right mar-

Table 3.—Extended.
micronucleus. 7, number of macronuclei. 8, number of micronuclei. 9, number of dorsal kineties. 10, number of adoral organelles. 11, number of right marginal cirri. 12, number of left marginal cirri. 13, number of frontal cirri. 14, number of ventral cirri. 15, number of transverse cirri. 16, number of caudal cirri. 17, structure of the paroral formation (d: diplostichomonad; st: stichomonad; sd: stichodyad; p: polystichomonad). 18, distance between the anterior pole and the posterior end of the ventral cirri zone. 19, number of buccal cirri. (d, data from the author's drawings.)

9	10	11	12	13	14	15	16	17	18	19
3	26–28	40–45	35–40	8–10	26–30	6–8	0	d	80 (d)	—
2	17–21	22–31	20–35	6–7	11–17	0	3	st + st	45 (d)	0
3	22–27	41–56	37–53	5–9	12–23	4–6	0	st + st	45–73	1
3–4	20–24	33–49	35–52	5–9	15–21	5–6	0	st + st	40–66	1
2–3	21–25	35–54	38–60	6–8	12–19	3–6	0	st + st	28–63	1
3	33	18–27	12–15	9	17–18	2	3	st + st	74 (d)	1
4	23–25	47–55	47–53	6	27–30	3	3	d	55 (d)	1
3	24–28	60	55	6	33–40	3	0	d + d	85 (d)	1
3	35	37–39	24–35	4	38	0	0	d	72 (d)	1
—	—	20	22	10	22	5	0	st	58 (d)	1
3	13–16	35–54	36–55	4	15–24	3	0	sd + sd	39–57	1
4	13–17	14–20	15–20	4	6–14	2–5	0	sd + st	23–21	1
4–5	13–17	13–19	11–19	4	8–12	3–5	0	sd + st	12–29	1
3	27–31	47–56	35–43	8	30–35	6–7	0	sd + sd	63–70	1
3	38–41	32–34	28–30	4	17–28	5	6–7	(d + st) + (st + p)	52–56	1
—	30–35	36–44	36–44	6–9	36–44	5	0	st	100 (d)	—
5–6	36–42	50–54	48–50	7	52–56	5–6	0	st + d	100.5–117	—
4	16–19	30–32	20–24	4	18–22	6–7	0	st + d	45–48.2	—

ginal cirri, each of them (1.56–1.86 μm long) having two rows of 4 kinetosomes each. These cirri dispose of a thick derivative (d1) arranged from cirrus to anterior right zone of ciliate; it is 2.4–3.18 μm long.

Left marginal cirri (LMC).—Located between posterior end of adoral zone of organelles and posterior pole, on left side of ventral surface. The zone of left marginal cirri has a length of 36.3–45 μm and its anterior end is 22.8–24.6 μm from anterior end of ciliate. This zone consists of 20–24 cirri, each one formed of two rows of 4 kinetosomes each. The 4–6 most posterior cirri have an additional row of 4 kinetosomes. Every cirrus (1.62–1.8 μm long) has two types of derivatives: d1) similar in disposition to derivate 'd1' of right marginal cirri and 2.46–4.2 μm long; and d2) a structure less thick than 'd1' and located from cirrus to left anterior area of organism with a length of 1.86–2.52 μm.

Ventral cirri (VC).—Constitute a group more or less sinuous, 26.5–31.6 μm long, situated in middle region of ventral surface, with anterior end near to paroral formation 2 (PF2). There are 18–22 ventral cirri, each one 1.69–1.92 μm long and formed of two rows: the anterior possesses 4–5 kinetosomes and the posterior one has 4–6 kinetosomes.

Directly above the transverse cirri and separated from the ventral cirri set, are two cirri of similar structure to the ventral cirri. These cirri are located 4.8–6 μm from transverse cirri set and are 1.44–1.74 μm long. They have two rows of 4–6 kinetosomes each.

Transverse cirri (TC).—There are six or seven transverse cirri located near posterior pole of organism. They are 45–52.5 μm from anterior end and 6.6–9.6 μm from posterior end of ciliate. Each cirrus is 1.62–1.86 μm long and 0.96–1.2 μm wide. Kinetosomic

Table 4.—Comparison of the arithmetic means (*t*) and variances (*f*) between *Amphisiella arenicola* (Species I) and the similar species (+, significant difference; −, non-significant difference; ( ) 99% signification; = data not available). a, *Holostichides terricola*. b, *Amphisiella australis* (Population I). c, *Amphisiella australis* (Population II). d, *Amphisiella magnigranulosa*. e, *Amphisiella acuta*. f, *Perisincirra gellerti* (Population I). g, *Perisincirra gellerti* (Population II). h, *Amphisiella terricola* (Foissner, 1984). i, *Amphisiella ovalis* (Species II). 1, length of the body. 2, width of the body. 3, length of the adoral zone of organelles. 4, length of each macronucleus. 5, width of each macronucleus. 6, length of the micronucleus. 7, number of macronuclei. 8, number of micronuclei. 9, number of dorsal kineties. 10, number of adoral organelles. 11, number of right marginal cirri. 12, number of left marginal cirri. 13, number of ventral cirri. 14, number of transverse cirri. 15, distance between the anterior pole and the posterior end of the ventral cirri zone.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	*t*	18.01	3.65	124.43	34.84	49.41	61.02	44.19	4.16	73.2	62.67	37.86	24.11	=	=	=
	Sig.	+	+	+	+	+	+	+	+	+	+	+	+	=	=	=
	f	3.10	15.59	11.19	4.07	3.05	1.8	0	0	0	1.89	8.38	33.20	=	=	=
	Sig.	+	+	+	+	+	+ (−)	−	−	−	−	+	+	=	=	=
b	*t*	5.96	1.83	69.52	6.12	7.27	42.88	0	4.28	53.2	31.84	0.10	1.27	33.32	0.23	17.59
	Sig.	+	−	+	+	+	+	−	+	+	+	−	−	+	−	+
	f	4.79	2.3	2.5	2.49	2.18	1.8	0	0	0	1	21.57	48.5	10.54	2.6	7.72
	Sig.	+	−	−	−	−	−	−	−	−	−	+	+	+	+	+
c	*t*	11.38	5.22	75.67	9.02	20	67.66	0	3.33	=	37.81	8.24	45.1	59.6	3.14	23.32
	Sig.	+	+	+	+	+	+	−	+	=	+	+	+	+	+	+
	f	3.73	1.16	2.31	1	2.18	1.25	0	0	=	1	23.32	54.24	3.91	1.8	5.88
	Sig.	+	+	+ (−)	−	−	−	−	−	=	−	+	+	+	+ (−)	+
d	*t*	12.86	1.86	83.72	5.54	14	44	0	4.19	19.06	41.13	7.75	2.04	64.75	1.18	21.71
	Sig.	+	+	+	+	+	+	−	+	+	+	+	+ (−)	+	−	+
	f	2.69	2.3	3.67	1.14	1.06	1.8	0	0	1.12	1.56	25.48	101.83	3.25	4.6	7.25
	Sig.	+ (−)	−	+ (−)	−	−	−	−	−	−	−	+	+	+	+	+
e	*t*	6.38	32.19	139.63	46.63	74.61	=	24.54	=	53.2	90.88	3.81	2.68	48.41	50.23	38.68
	Sig.	+	+	+	+	+	=	+	=	+	+	+	+	+	+	+
	f	7.57	87.42	16.4	14.18	12.88	=	0	0	0	4.62	33.12	65.62	5.08	0	2.57
	Sig.	+	+	+	+	+	=	−	−	−	+	+	+	+	−	+
f	*t*	30.58	32.9	122.5	30.2	22.77	=	10.3	=	33.2	54.25	63.61	73.63	65.01	6.64	102.01
	Sig.	+	+	+	+	+	=	+	=	+	+	+	+	+	+	+
	f	1.59	32.25	10.77	3.44	1.15	=	0	0	0	1.29	3.36	4.01	3.65	8.93	2.47
	Sig.	−	+	+	+ (−)	−	=	−	−	−	−	+	+	+	+	−

Table 4.—Continued.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
g	*t*	49.91	33.43	92.32	39	52.35	=	33.52	=	7.81	23.2	73.92	53.65	132.6	9	67.48
	Sig.	+	+	+	+	+	=	+	=	+	+	+	+	+	+	+
	f	1.3	28.31	3.31	6.23	4.29	=	0	0	1.41	2.24	2.94	9.77	1.01	1.8	1.44
	Sig.	−	+	+ (−)	+	+	=	−	−	−	−	+	+	−	−	−
h	*t*	12.75	0.04	112.6	11.54	3.66	=	0	=	=	12.75	1.15	7.62	18.56	=	=
	Sig.	+	−	+	+	+	=	−	=	=	+	−	+	+	=	=
	f	2.22	1.07	39.02	2.45	2.63	=	0	0	=	1.17	22.71	22.64	5.52	=	=
	Sig.	−	−	+	−	−	=	−	−	=	−	+	+	+	=	=
i	*t*	101.2	12.27	108.93	50.52	70.9	257.5	93.29	6.25	33.2	104.15	148.78	132.95	266.66	26.5	151.29
	Sig.	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
	f	2.38	2.35	2.56	8.22	3.62	5	0	0	0	2.98	1.37	2.18	1.15	1.33	19.26
	Sig.	+	+	+	+	+	+	−	−	−	+	−	+	−	−	+

composition varies among cirri. Numbered from left to right, the number of kinetosomes of each row is the following:

T1 = 3–4 + 4 + 3–4
T2 = 3 + 3–4 + 4
T3 = 4 + 4 + 3–4
T4 = 4–6 + 4–6 + 4–5
T5 = 3 + 3–4 + 3
T6 = 4 + 4 + 3–4
T7 = 3–4 + 4–6 + 4–6

Taxonomic Position

The two species studied belong to subkingdom Protozoa Goldfuss, 1818, emd. Von Siebold, 1846; phylum Ciliophora Doflein, 1901; subphylum Postciliodesmatophora Gerassimova & Seravin, 1976; class Spirotrichea Bütschli, 1889; subclass Stichotrichia Small & Lynn, 1985 and order Stichotrichida Fauré-Fremiet, 1961 (Lee et al. 1985, Corliss 1979). The species most similar (infraciliature and nuclear structures principally) to these ciliates are: a) *Amphisiella terricola* Gellért, 1955 (Hemberger 1982); b) *Holostichides terricola* Foissner, 1988; c) *Amphisiella australis* Blatterer & Foissner, 1988 (Population I); d) *Amphisiella australis* Blatterer & Foissner, 1988 (Population II); e) *Amphisiella magnigranulosa* Foissner, 1988; f) *Trachelochaeta gonostomoida* Hemberger, 1985; g) *Uroleptoides atypica* Hemberger, 1985; h) *Uroleptoides binucleata* Hemberger, 1985; i) *Uroleptoides caudata* Hemberger, 1985; j) *Amphisiella capitata* Perejaslawzewa, 1886; k) *Amphisiella acuta* Foissner, 1982; l) *Perisincirra gellerti* Foissner, 1982 (Population I); m) *Perisincirra gellerti* Foissner, 1982 (Population II); n) *Amphisiella terricola* Gellért, 1955 (Foissner 1984); o) *Amphisiella oscensis* Fernandez-Leborans, 1984; and p) *Amphisiella milnei* Kahl, 1932 (Agamaliev 1983; Foissner 1982, 1984, 1988; Blatterer & Foissner 1988; Hemberger 1985; Borror 1972; Fernandez-Leborans 1984b).

The organisms described have been compared with these similar species, taking into

Table 5.—Comparison of the arithmetic means (*t*) and variances (*f*) between *Amphisiella ovalis* (Species II) and the similar species (+, significant difference; −, non-significant difference; ( ) 99% significance; = data not available). a, *Holostichides terricola*. b, *Amphisiella australis* (Population I). c, *Amphisiella australis* (Population II). d, *Amphisiella magnigranulosa*. e, *Amphisiella acuta*. f, *Perisincirra gellerti* (Population I). g, *Perisincirra gellerti* (Population II). h, *Amphisiella terricola* (Foissner, 1984). 1, length of the body. 2, width of the body. 3, length of the adoral zone of organelles. 4, length of each macronucleus. 5, width of each macronucleus. 6, length of the micronucleus. 7, number of macronuclei. 8, number of micronuclei. 9, number of dorsal kineties. 10, number of adoral organelles. 11, number of right marginal cirri. 12, number of left marginal cirri. 13, number of ventral cirri. 14, number of transverse cirri. 15, distance between the anterior pole and the posterior end of the ventral cirri zone.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
a	*t*	12.25	1.99	23.69	1.97	4	5.57	48.13	1.92	9.09	5	8.93	1.93	=	=	=
	Sig.	+	−	+	−	+	+	+	−	+	+	+	−	=	=	=
	f	7.40	37.23	4.37	2.01	1.18	9	7.67	1.68	0	1.57	11.5	15.19	=	=	=
	Sig.	+	+	+	+ (−)	−	+	+	−	−	−	+	+	=	=	=
b	*t*	15.91	6.28	4.32	25.48	31	16.12	93.29	2.41	0	15.11	15.76	17.47	0.63	8.61	4.43
	Sig.	+	+	+	+	+	+	+	+ (−)	−	+	+	+	−	+	+
	f	11.42	1.02	0.97	3.30	1.65	9	0	1.73	0	2.98	29.58	22.19	12.18	1.95	148.75
	Sig.	+	−	−	+	−	+	−	−	−	+	+	+	+	+ (−)	+
c	*t*	14.15	7.83	11.18	12.13	21.11	21.8	93.29	1.15	=	10.23	7.42	13.95	3.86	11.36	2.77
	Sig.	+	+	+	+	+	+	+	−	=	+	+	+	+	+	+
	f	8.89	2.01	1.10	8.19	1.65	4	0	1.38	=	2.96	32	24.82	4.51	1.35	113.43
	Sig.	+	+ (−)	−	+	−	+	−	−	=	+	+	+	+	−	+
d	*t*	16.04	10.32	9.55	16.5	12.85	14.87	93.29	2.5	8.57	14.44	6.71	10.92	6.13	8.40	0.92
	Sig.	+	+	+	+	+	+	+	+ (−)	+	+	+	+	+	+	−
	f	6.42	1.02	1.43	7.18	3.40	9	0	2.09	0	1.91	34.96	46.60	3.75	3.45	139.69
	Sig.	+	−	−	+	+	+	−	+ (−)	−	+ (−)	+	+	+	+	+
e	*t*	11.04	26.35	42.44	3.72	19	=	6.67	=	0	12.72	8.88	13.53	1.17	75	1.35
	Sig.	+	+	+	+	+	=	+	=	−	+	+	+	−	+	−
	f	18.05	37.05	6.40	1.72	3.55	=	1.39	=	0	1.54	45.43	30.03	5.87	0	49.57
	Sig.	+	+	+	−	+	=	−	=	−	−	+	+	+	−	+
f	*t*	3.35	27.07	32.69	0.13	1.14	=	40.32	=	0	6.09	27.07	12.91	14.26	11	28.37
	Sig.	+	+	+	−	−	=	+	=	−	+	+	+	+	+	+
	f	3.79	13.67	4.20	2.38	4.18	=	2.82	=	0	2.30	4.61	1.83	4.22	6.7	7.78
	Sig.	+	+	+	+	+	=	+ (−)	=	−	+ (−)	+	+ (−)	+	+	+

Table 5.—Continued.

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
g	t	0.42	27.80	21.66	1.47	7.33	=	73.97	=	8	9	32.91	11.26	29.57	19	19.57
	Sig.	−	+	+	−	+	=	+	=	+	+	+	+	+	+	+
	f	1.82	12	1.29	1.31	1.18	=	35.43	=	0	1.32	4.03	4.47	1.13	1.35	27.88
	Sig.	+(−)	+	−	−	−	=	+	=	−	−	+	+	−	−	+
h	t	9.37	4.07	5.08	8.8	23.92	=	93.29	=	=	17.5	8.62	11.42	10.24	=	=
	Sig.	+	+	+	+	+	=	+	=	=	+	+	+	+	=	=
	f	5.28	2.18	15.24	3.34	1.37	=	0	=	=	3.51	31.15	10.36	6.38	=	=
	Sig.	+	−	+	+	−	=	−	=	=	+	+	+	+	=	=

account 19 characteristics: 1) length of the body; 2) width of the body; 3) length of the adoral zone of organelles; 4) length of each macronucleus; 5) width of each macronucleus; 6) length of the micronucleus; 7) number of macronuclei; 8) number of micronuclei; 9) number of dorsal kineties; 10) number of adoral organelles; 11) number of right marginal cirri; 12) number of left marginal cirri; 13) number of frontal cirri; 14) number of ventral cirri; 15) number of transverse cirri; 16) number of caudal cirri; 17) structure of the paroral formation (d: diplostichomonad; st: stichomonad; sd: stichodyad; p: polystichomonad); 18) distance between the anterior pole and the posterior end of the ventral cirri zone; and 19) number of buccal cirri. The number of differences, in relation to these characteristics, between 'Species I' and the other species are: 13 with respect to *Amphisiella terricola* (Hemberger 1982) (a); 16 (b); 8 (c); 10 (d); 10 (e); 14 (f); 16 (g); 13 (h); 16 (i); 10 (j); 14 (k); 15 (l); 13 (m); 13 (n); 14 (o); and 9 with respect to species (p). The number of differences in relation to 'Species II' are: 15 (a); 10 (b); 12 (c); 11 (d); 12 (e); 16 (f); 13 (g); 16 (h); 14 (i); 8 (j); 10 (k); 10 (l); 11 (m); 13 (n); 12 (0) and 13 with respect to species (p). There are 14 differences between the two species studied (Table 3).

On the other hand, a comparative analysis has been made of the arithmetic means and variances. The species with statistical indexes described in the literature have been considered. These species are: a) *Holostichides terricola*; b) *Amphisiella australis* (Population I); c) *Amphisiella australis* (Population II); d) *Amphisiella magnigranulosa*; e) *Amphisiella acuta*; f) *Perisincirra gellerti* (Population I); g) *Perisincirra gellerti* (Population II); h) *Amphisiella terricola* (Foissner 1984). For this analysis the following characteristics have been compared: 1) length of the body; 2) width of the body; 3) length of the adoral zone of organelles; 4) length of each macronucleus; 5) width of each macronucleus; 6) length of the micro-

nucleus; 7) number of macronuclei; 8) number of micronuclei; 9) number of dorsal kineties; 10) number of adoral organelles; 11) number of right marginal cirri; 12) number of left marginal cirri; 13) number of ventral cirri; 14) number of transverse cirri; and 15) distance between the anterior pole and the posterior end of the ventral cirri zone.

In the comparison of arithmetic means, 'Species I' has the lesser number of significant differences (7) with respect to *Amphisiella terricola,* followed by *Amphisiella australis* (Population I) (10), whereas in the comparison of variances the lesser number of significant differences (4) corresponds to *Amphisiella terricola,* followed by *Perisincirra gellerti* (Population II) (6, significance level 95%; 5, significance level 99%) (Table 4).

'Species II' has, on the comparison of arithmetic means, the lesser number of significant differences (8) with respect to *Holostichides terricola,* followed by *Amphisiella acuta* (10), *Perisincirra gellerti* (Population I) (10) and *Amphisiella terricola* (10). In the comparison of variances the lesser number of significant differences refer to *Perisincirra gellerti* (Population II) (6, significance level 95%; 5, significance level 99%), followed by *Amphisiella terricola.* The comparison of arithmetic means between the two species studied shows 15 significant differences (Table 5).

Taking into account this data, we believe that both species belong to the genus *Amphisiella,* and there are sufficient differences with respect to the morphologic features to indicate that they are two new species: *Amphisiella arenicola,* n. sp. ('Species I') and *Amphisiella ovalis,* n. sp. ('Species II'). Type specimens: permanent slides staining with silver carbonate technique, deposited in the Laboratorio de Biología General, Facultad de Biología, Universidad Complutense de Madrid, ref. n. 1663a–f (*Amphisiella arenicola*), ref. n. 1665a–l (*Amphisiella ovalis*)

Acknowledgments

This work was supported by Dirección General de Investigación Científica y Técnica (M.E.C.) grant PA86-0184.

Literature Cited

Agamaliev, F. G. 1983. Ciliates of the Caspian Sea. Systematics, Ecology, Zoogeography. Nauka, Leningrad, 220 pp.

Blatterer, H., & W. Foissner. 1988. Beitrag zur terricolen Ciliatenfauna (Protozoa: Ciliophora) Australiens.—Stapfia 17:1–84.

Borror, A. C. 1963. Morphology and ecology of the benthic ciliated protozoa of Alligator Harbor, Florida.—Archiv für Protistenkunde 106:465–534.

———. 1965. New and little-known tidal marsh ciliates.—Transactions of the American Microscopical Society 84:550–565.

———. 1972. Revision of the order Hypotrichida (Ciliophora, Protozoa).—Journal of Protozoology 19:1–23.

Bütschli, O. 1889. Protozoa. Abt. III. Infusoria und System der Radiolaria. Pp. 1098–2035 *in* Klassen und Ordnung des Thiers-Reichs. C. F. Winter, Leipzig.

Corliss, J. O. 1979. The ciliated protozoa. Characterization, classification and guide to the literature. Pergamon Press, Oxford, 455 pp.

Doflein, F. 1901. Die Protozoen als Parasiten und Krankbeitserreger nach biologischen Gesichtspunkten dargestellt. G. Fischer, Jena, 274 pp.

Dragesco, J. 1960. Ciliés mésopsammiques littoraux. Systématique, morphologie, écologie.—Travaux de la Station Biologique de Roscoff 12:1–356.

———, & A. Dragesco-Kérneis. 1986. Ciliés libres de l'Afrique intertropicale. Ed. Institut Français de Recherche Scientifique pour le Développement en coopération. Collection Faune Tropicale nº 26, 559 pp.

Fauré-Fremiet, E. 1961. Remarques sur la morphologie comparée et la systématique des Ciliata Hypotrichida.—Comptes Rendues de l'Academie des Sciences 252:3515–3519.

Fernandez-Leborans, G. 1984a. The morphology of the infraciliature and fibrillar systems of the marine ciliate *Pleurotricha planensis* sp. nov.—Journal of Natural History 18:939–948.

———. 1984b. Description of *Amphisiella oscensis* sp. nov. (Protozoa: Ciliophora).—Journal of Natural History 18:25–30.

———. 1990. The morphology and the taxonomic

position of a protozoan of the genus *Zosterodasys* (Ciliophora, Nassophorea).—Zoologische Jahrbücher Anatomie 120:81–91.

———, & M. Castro de Zaldumbide. 1984. Morphology of three species of free-living marine ciliata, *Pseudocohnilembus cantabricus* n. sp., *Paralembus asturianus* n. sp., *Uronema castellonensis* n. sp. (Ciliophora, Scuticociliatida).—Archiv für Protistenkunde 128:159–168.

———, & ———. 1985. Morphogenesis of bipartition of *Euplotes mediterraneus* n. sp. (Ciliophora, Hypotrichida).—Zoologische Jahrbücher Anatomie 113:477–492.

———, & ———. 1986a. The morphology of *Anophrys arenicola* sp. nov. (Ciliophora, Scuticociliatida).—Journal of Natural History 20:713–721.

———, & ———. 1986b. Two new marine scuticociliates: *Pseudocohnilembus antoniensis* and *Pseudocohnilembus portuensis* (Ciliophora).—Microbios 47:7–22.

Foissner, W. 1979. Ökologische und systematische Studien über das Neuston alpiner Kleingewässer, mit besonderer Berücksichtigung der Ciliaten.—International Revue der gesammten Hydrobiologie 64:99–140.

———. 1982. Ökologie und Taxonomie der Hypotrichida (Protozoa: Ciliophora) einiger österreichischer Böden.—Archiv für Protistenkunde 126:19–143.

———. 1984. Infraciliatur, Silberliniensystem und Biometrie einiger neuer und wenig bekannter terrestrischer, limnischer und mariner Ciliaten (Protozoa: Ciliophora) aus den Klassen Kinetofragminophora, Colpodea und Polyhymenophora.—Stapfia 12:1–165.

———. 1988. Gemeinsame Arten in der terricolen Ciliatenfauna (Protozoa: Ciliophora) von Australien und Afrika.—Stapfia 17:85–133.

Gellért, J. 1955. Die Ciliaten des sich unter der Flechte *Parmelia saxatilis* Mass. gebildeten Humus.—Acta Biologica Hungarica 6:77–111.

Gerassimova, Z. P., & L. N. Seravin. 1976. Ectoplasmic fibrillar system of Infusoria and its role for the understanding of their phylogeny.—Zoologichesky Zhurnal 55:645–656.

Goldfuss, G. A. 1818. See "Handbuch der Zoologie" (1820). J. L. Schrag, Nürnberg, 696 pp.

Hemberger, H. 1982. Revision der Ordnung Hypotrichida Stein (Ciliophora, Protozoa) an Hand von Protargolpräparaten und Morphogenesedarstellungen. Unpublished Ph.D. dissertation, University of Bonn, 296 pp.

———. 1985. Neue Gattungen und Arten hypotricher Ciliaten.—Archiv für Protistenkunde 130: 387–417.

Honigberg, B. M., et al. 1964. A revised classification of the phylum Protozoa.—Journal of Protozoology 11:7–20.

Kahl, A. 1935. Urtiere oder Protozoa. I: Wimpertiere oder Ciliata (Infusoria). G. Fischer, Jena, 886 pp.

Lee, J. J., S. H. Hutner, & E. C. Bovee. 1985. An illustrated guide to the Protozoa. Allen Press, Lawrence, 629 pp.

Levine, N. D., et al. 1980. A newly revised classification of the Protozoa.—Journal of Protozoology 27:37–58.

Small, E. B. & D. H. Lynn. 1985. Phylum Ciliophora. Pp. 393–575 *in* J. J. Lee, S. H. Hutner, & E. C. Bovee, Illustrated guide to the protozoa. Society of Protozoologists, Allen Press, Lawrence, Kansas.

Song, W., & N. Wilbert. 1989. Taxonomische Untersuchungen an Aufwuchsciliaten (Protozoa, Ciliophora) im Poppelsdorfer Weiher, Bonn. Lauterbornia, Dinkelscherben, 222 pp.

Stein, F. 1859. Der Organismus der Infusionsthiere nach eigenen Forschungen in Systematischer Reihenfolge Bearbeitet. I. Leipzig, 206 pp.

Von Siebold, C. T. 1846. [See "Lehrbuch der Vergleichenden Anatomie der Wirbellosen Thiere" (1848).] Pp. 1–679 *in* Lehrbuch der Vergleichenden Anatomie, C. T. von Siebold & Stannius, Berlin.

Laboratorio de Biología General, Facultad de Biología, Universidad Complutense, 28040 Madrid, Spain.